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(54) A Thermally Insulated Frame for Use in a Building

(57) A thermally insulated frame for use in a building comprises spaced inner and outer metal frame members (11, 12), and a thermal barrier (14) provided by a pair of facing, parallel, thermally insulating channel members (16) extending along the gap between the frame members to bridge the gap and interconnect the frame members. Each channel member has a pair of legs respectively received in grooves formed in the two frame members. Each groove has two facing, longitudinally serrated side walls, and each leg has two opposed surfaces both bearing longitudinal barbs for simultaneously interlocking with the facing wall serrations of the groove in which the leg is received. The grooves are dimensioned, in relation to the legs, to enable press-fitting insertion of the legs into the grooves.

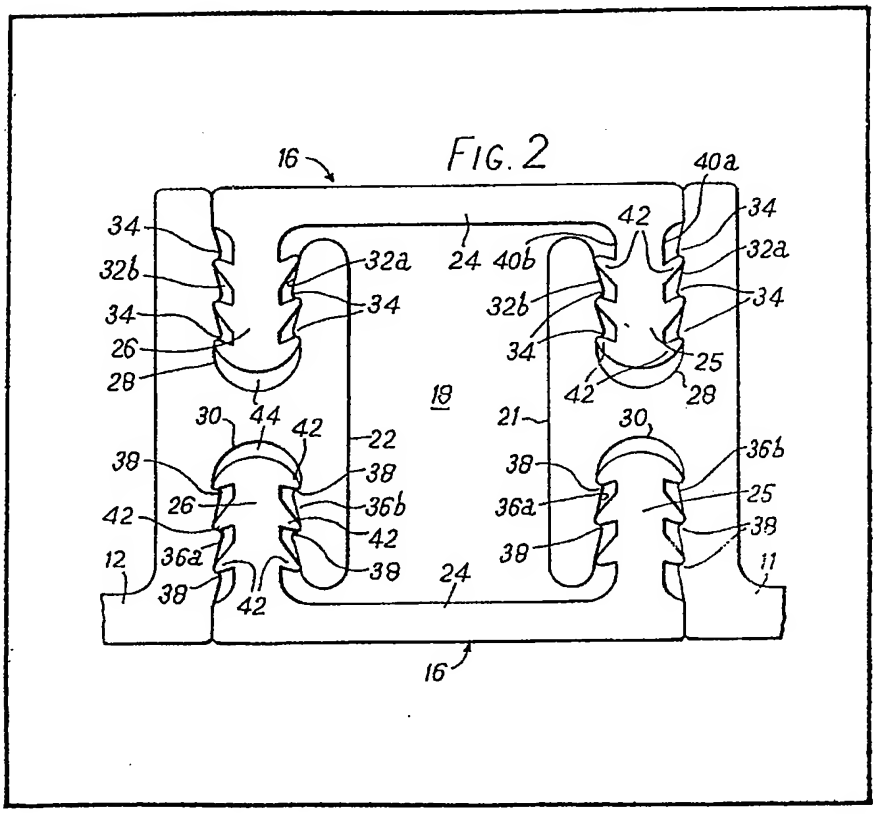

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FIG. 1

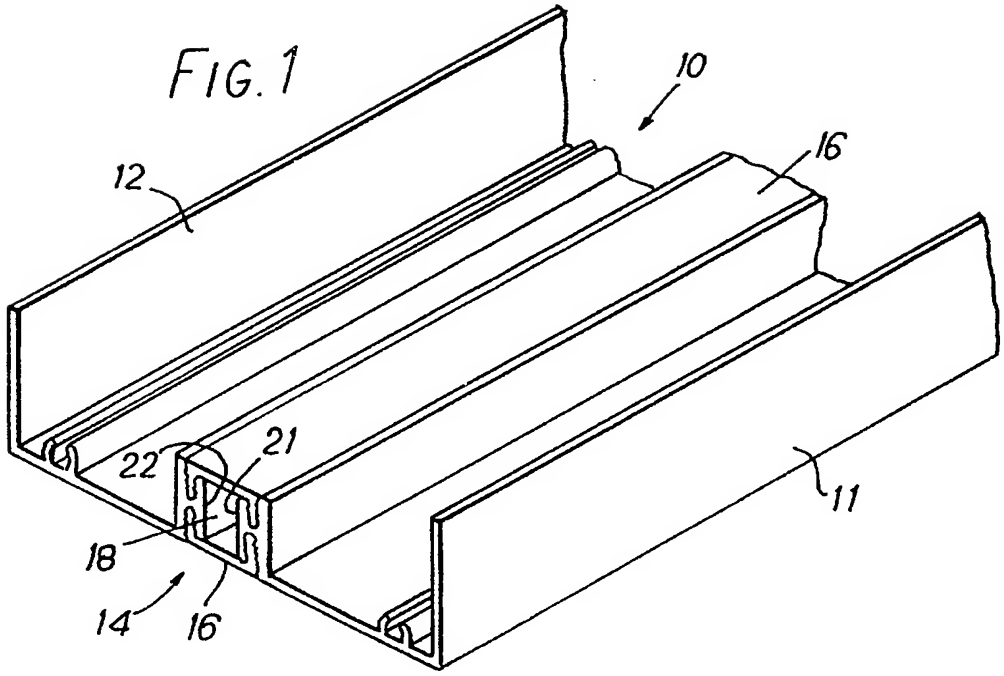

FIG. 2

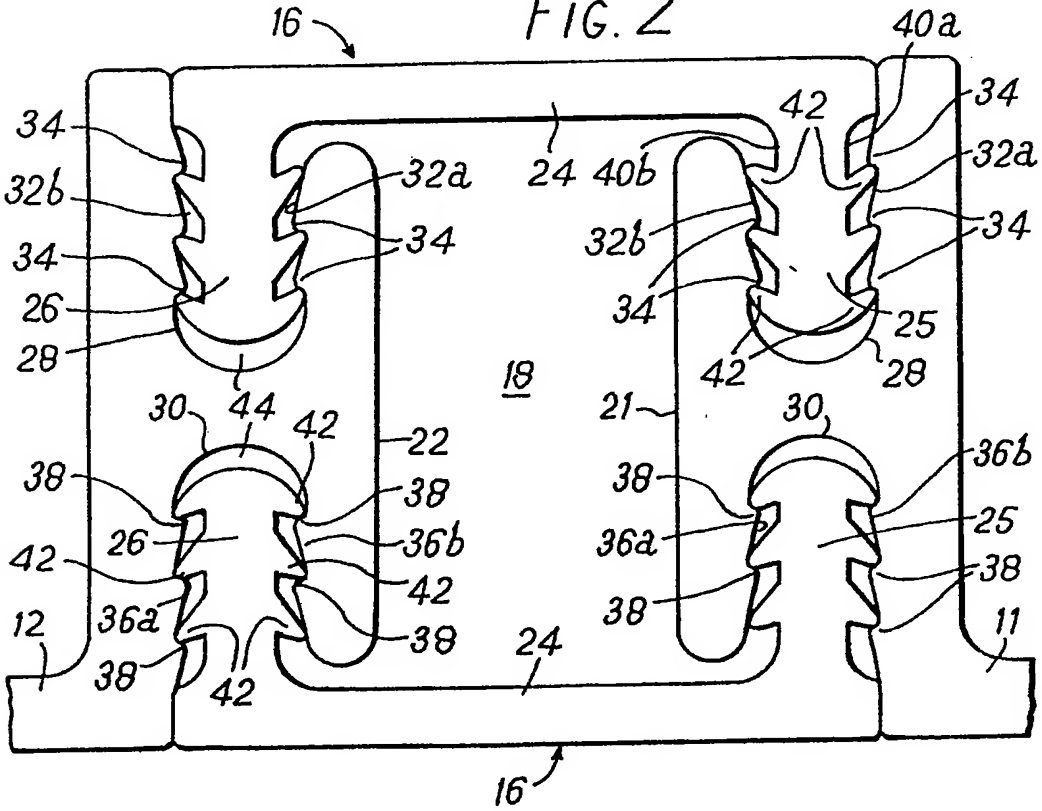

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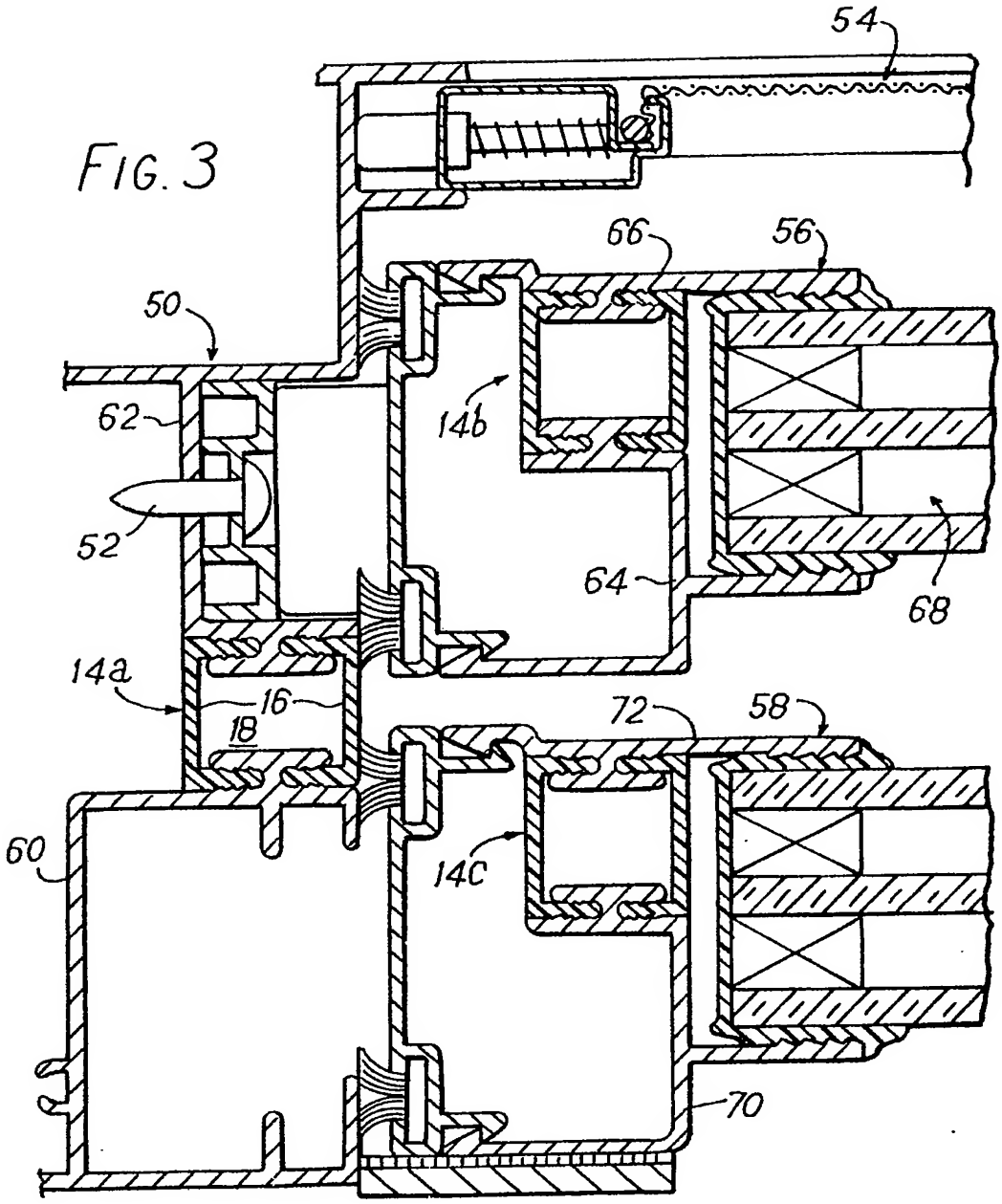
FIG. 3



SPECIFICATION

A Thermally Insulated Frame For Use in a Building

This invention relates to thermally insulated frames for use in buildings, and more particularly to frames comprising inner and outer metal frame members interconnected by a thermal barrier for retarding heat conduction between the interior and exterior of a building.

In present-day building constructions, it is well known to employ structural frames of metal for such elements as door and window frames and sashes. Metal frames afford various advantages, including durability and ease of installation and maintenance. Owing, however, to the relatively high thermal conductivity of metals, a metal frame which is exposed to both the interior and exterior of a building provides a path for rapid heat transfer through the building wall, derogating from desired thermal insulation of the structure. The minimizing of such heat losses is especially important from the standpoint of energy consumption.

Accordingly, it has been proposed to provide metal frames (e.g. window and door frames) as assemblies of inner and outer metal frame members separated from each other but interconnected structurally by a so-called thermal break or barrier, viz. a body or bodies of material of thermal conductivity lower than the metal. For example, the interconnecting thermal barrier may be constituted of polyurethane poured into and solidified between the inner and outer frame members while being laterally confined as by a metal wall initially formed integrally with and extending between the inner and outer frame members but machined away after the polyurethane has solidified; such arrangements, however, are inconveniently complex and difficult to produce, owing *inter alia* to the fact that substantial time is required for solidification of the thermal barrier material. Alternatively, a thermal break may be constituted of extruded plastic members (commonly fabricated of polyvinyl chloride) of roll-lock or snap-on type but again, known forms of such members tend to be structurally complex, inconvenient to install, and/or vulnerable to dis-engagement especially when a frame assembly incorporating them is subjected to rotational stress. In addition, use of the latter members generally requires observance of very close dimensional tolerances.

The present invention broadly contemplates the provision of a thermally insulated frame comprising spaced inner and outer metal frame members extending in parallel planes to each other and interconnected by a pair of substantially rigid parallel elongate thermally insulating channel members which bridge the gap between the frame members and which are disposed with the legs of each channel member projecting towards the legs of the other channel member, each channel member having one leg engaged in a groove in one of the frame members and its other leg engaged in a groove in the other frame member, the two channel members forming with the frame members a laterally enclosed lengthwise-extending air space in the gap, both side walls of each groove being formed with lengthwise extending serrations and the legs of the channel members having both sides thereof formed with a plurality of lengthwise extending barbs which interlock with the grooves to retain the legs in the grooves, the cross-sectional dimensions of each of which grooves is sufficiently large in relation to those of the leg to enable the leg to be press-fitted into the groove.

The term "thermally insulating", as used herein with reference to the channel members, means that the material of which the channel members are made has substantially lower thermal conductivity than the frame members. Typically or preferably, the channel members are extrusions constituted of an organic polymeric material, e.g. a synthetic resin such as polyvinyl chloride, and are not only self-sustaining in shape but are characterized by relatively high tensile and compression strength.

In the frame according to the present invention, the facing channel members cooperatively constitute a thermal barrier of boxlike configuration affording desirable structural strength, and assuring that when the assembly is subjected to rotational stress about its long axis the individual channel members are under tension and compression rather than flexural stress, thereby to take advantage of the mechanical properties of a thermally insulating material such as polyvinyl chloride which, though having low flexural strength, has substantial tensile and compressive strength. Especially important for attainment of the desired results are the provision of longitudinal barbs on each side of each channel member leg and the complementary provision of longitudinal serrations on both facing walls of each frame member groove. The interlocking thereby achieved (effected by force fit of the legs into the grooves; i.e. by deformation of the substantially rigid vinyl under force with cold flow of the barbs into place such that the barbs are wedged and retained under the serrations) prevents dislodgement of the channel members under torsional forces, but, advantageously, is attainable with relatively wide dimensional tolerances, owing to the presence of barbs and mating wall serrations on both sides of each leg.

Production of the completed assembly is rapid and simple, requiring no time delay for solidification of the thermal barrier, nor any step of removing an initial liquid-containing metal wall or bridge between the inner and outer metal frame members. The thermal barrier has highly satisfactory insulating properties, owing to the superior insulating effect of the air space defined between the channel members within the gap as well as to the low thermal conductivity of the channel members themselves. Consequently, frames embodying the invention can be used for a wide variety of building elements, including (but

not limited to) window frames, door frames and the like.

The invention will now be described in more detail with reference by way of example to the accompanying drawings in which:

Figure 1 is a simplified fragmentary perspective view of an illustrative frame assembly embodying the present invention in a particular form;

Figure 2 is an enlarged sectional view of the thermal barrier channel members and associated portions of the metal frsme members of the assembly of Figure 1, and

Figure 3 is a fragmentary sectional plan view of a window frame incorporating the invention.

Referring first to Figures 1 and 2, there is shown a building structure frame assembly 10 embodying the invention and comprising an inner metal frame member 11, an outer metal frame member 12, and a thermal barrier or break 14 comprising a pair of facing, thermally insulating channel members 16 that interconnect the two metal frame members. As will be understood, the assembly 10 is intended to represent, in a somewhat simplified schematic way, a frame (such as a window or door frame) arranged to be mounted in a building wall such that the inner frame member 11 is exposed to the interior of the building and the outer frame member 12 is exposed to the exterior of the building.

Each of the frame members 11 and 12 is an elongate unitary integral member formed of a metal such as aluminum (i.e. pure aluminum metal or an alloy thereof) and is conveniently produced by extrusion in conventional manner. For simplicity of illustration, the members 11 and 12 are shown as having cross sections or profiles which are mirror images of each other, but in practice (as will be understood particularly by reference to Figure 3, described below), these members need not be identical or even similar in configuration except in the portions thereof immediately adjacent the thermal barrier.

The two members 11 and 12 are disposed in closely spaced parallel relation to each other so as mutually to define a parallel-sided, elongate gap 18 between them. Specifically, in the illustrated embodiment, this gap is defined between a planar longitudinal surface 21 of member 11 facing member 12, and a planar longitudinal surface 22 of member 12 facing member 11.

Each of the channel members 16 is a substantially rigid element composed of a material which is substantially lower in thermal conductivity than is the metal of frame members 11 and 12. In the present embodiment of the invention, the members 16 are made of polyvinyl chloride and are produced by extrusion in conventional manner, being dimensioned to be self-sustaining in shape. As shown, each of the channel members 16 has a central web 24 and a pair of parallel legs 25 and 26 respectively extending along opposite edges of the web. In the assembly of Figures 1 and 2, the legs of each of the two channel members 16 project toward the legs of the other channel member. The two channel members extend along the gap 18 in facing, spaced parallel relation to each other so as to bridge the gap and to interconnect the frame members 11 and 12 to form therewith a structurally stable assembly having a laterally enclosed longitudinal air space in the gap.

Each of the frame members has a first groove 28 extending along the gap for receiving one of the legs of one of the channel members 16, and a second, oppositely opening groove 30 extending along the gap for receiving one of the legs of the other of the channel members 16, such that the legs of each channel member are respectively received in grooves of the two frame members on opposite sides of the gap. It will be seen that the groove 28 on each side of the gap is aligned with the groove 30 on the same side of the gap, such that the two channel members 16 (which are equal to each other in width) are disposed in register with each other to constitute a thermal barrier of box-like configuration.

Each of the grooves 28 has two facing side walls 32*a* and 32*b* each of which bears plural parallel longitudinal serrations 34. It will be understood that these serrations are riblike projections protruding toward the centre of the groove from the walls and extending along the length of the groove. Similarly, each of the grooves 30 has two facing side walls 36*a* and 36*b* each bearing plural parallel longitudinal serrations 38 identical to the serrations 34 of the grooves 28. The serrations are integral with the groove walls, and may be produced conveniently by use of an appropriately configured extruding die in the extrusion of the members 10 and 11.

Each of the channel member legs 25 and 26 has two opposed side surfaces 40*a* and 40*b* both bearing plural, resiliently deformable parallel longitudinal barbs 42 for simultaneously interlocking with the facing wall serrations 34 or 38 of a groove 28 or 30 when the leg is received in the groove, thereby to retain the leg in the groove. These barbs are projections extending along the full length of the channel member legs and are integral therewith, being formed during extrusion of the channel members.

The cross-sectional dimensions of each groove 28 and 30 are sufficiently large, in relation to the channel member leg received therein, to enable press-fitting insertion of the leg in the groove. That is to say, the relative dimensions of the groove and leg are such that, with the metal frame members 11 and 12 positioned as shown in Figures 1 and 2, the channel members 16 can be mounted (to interconnect the frame members) by force fitting insertion of their legs in the grooves; and when so mounted, they are retained in place by interference of the barbs of the channel member legs with the serrations of the groove walls along both sides of each leg. To accommodate the deformation of the channel member legs necessary to achieve the described force fitting, it is advantageous to so shape and dimension the grooves that when the legs are finally inserted, there is a space 44 between the

extremity of each leg and the bottom of the groove in which the leg is received.

It will be appreciated that in the frame assembly of Figures 1 and 2, the inner and outer metal frame members 11 and 12 are completely thermally isolated from each other by the thermal barrier 14 constituted of the pair of channel members 16 and having the confined air space within gap 18. The components of this assembly are readily and conveniently manufactured as by conventional extruding techniques, and are put together with advantageous facility by simple positioning of the metal frame members and force fitting of the thermally insulated channel members into place. The produced assembly is structurally stable and fully capable of withstanding the loads to which such frames are ordinarily subjected in use.

By way of illustration of one specific environment of use for the frame assembly of the present invention, there is shown in Figure 3 an exemplary type of window frame system incorporating the invention. This system, adapted to be mounted in a building wall (not shown), includes a window frame assembly 50 arranged to be fixedly secured at a window opening of a wall as by fasteners 52 and to support, for independent vertical sliding movement, a window screen 54, an upper window sash 56, and a lower window sash 58, the screen 54 being located on the outer side of the building.

The window frame assembly 50 comprises an inner extruded aluminum frame member 60 and an outer aluminum frame member 62 which are interconnected but thermally isolated by a thermal barrier 14*a* in accordance with the invention. The thermal barrier 14*a* can be essentially identical to the thermal barrier 14 of Figures 1 and 2; thus as shown, it is constituted of a facing pair of thermally insulated channel members 16 having barbed legs force-fittingly received in serrated grooves formed in the frame members 60 and 62 along the gap 18 defined between the frame members. Similarly, the window sash 56 comprises an inner extruded aluminum frame member 64 and an outer extruded aluminum frame member 66 which cooperatively hold an assembly 68 of glass window panes. The inner and outer frame members of the sash 56 are interconnected but thermally isolated by means of a thermal barrier 14*b* which can again be essentially identical to the barrier 14 of Figures 1 and 2. The sash 58 may be of like construction with inner and outer extruded aluminum frame members 70 and 72 interconnected by a thermal barrier 14*c* of the same type. As will be appreciated, in Figure 3, features of structure of the frame system not pertinent to the present invention have been omitted for simplicity of illustration.

Claims

1. A thermally insulated frame comprising spaced inner and outer metal frame members extending in parallel planes to each other and interconnected by a pair of substantially rigid parallel elongate thermally insulating channel members which bridge the gap between the frame members and which are disposed with the legs of each channel member projecting towards the legs of the other channel member, each channel member having one leg engaged in a groove in one of the frame members and its other leg engaged in a groove in the other frame member, the two channel members forming with the frame members a laterally enclosed lengthwise-extending air space in the gap, both side walls of each grooove being formed with lengthwise extending serrations and the legs of the channel members having both sides thereof formed with a plurality of lengthwise extending barbs which interlock with the grooves to retain, the legs in the grooves, the cross-sectional dimensions of each of which grooves is sufficiently large in relation to those of the leg to enable the leg to be press-fitted into the groove.

2. A frame as claimed in claim 1, wherein said frame members are extrusions.

3. A frame as claimed in claim 1 or claim 2, wherein said channel members are extrusions made from polyvinyl chloride.

4. A thermally insulated frame substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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